5.8.2 Transformers

Customer-owned transformers allow facilities to purchase power at lower costs and then step down electric utility power distribution line voltages to lower secondary voltages needed for internal applications. Transformers commonly used for powering large facilities are either liquid-filled, dry-type, or epoxy cast resin. Liquid-filled transformers may be pole-mounted for overhead distribution, pad-mounted for underground feed in and out, or station-class for lineup application with switchgear. Dry-type transformers are used both in medium-voltage applications, such as substations, and in low-voltage (less than 600-volt primary) step-down applications, such as plugloads and lighting. Dry-type transformers are typically located inside buildings away from harsh environments. Proper transformer selection is important to ensure robust application and to minimize the potential for catastrophic failure. Energy efficiency considerations are particularly important and can result in rapid recovery of incremental investments.

Opportunities

Purchase energy-efficient transformers and practice good installation techniques whenever replacing or adding new equipment. Conduct proactive transformer maintenance along with other electrical maintenance functions.

Technical Information

Efficiencies of low-voltage dry-type transformers, designed only for temperature rises, will range from 95% to 98%, with core losses caused by magnetizing and coil losses caused by impedance and resistance. NEMA Standard TP 1-1996 was established to define energy-efficient liquid and dry-type transformers. TP 1-compliant transformers will range from a low of 97.0% efficiency for 15 kVA dry-type to 98.9% efficient for 1,000 kVA low-voltage dry-type. Medium-voltage dry-type transformers, designed to meet the NEMA Standard, will range from 96.8% efficiency at 15 kVA to 99.1% efficiency at 2,500 kVA. Low-voltage dry-type transformers meeting the TP 1-1996 requirements also qualify for an ENERGYSTAR® label. When purchasing transformers, look for those with high efficiency ratings that meet your needs. Be sure to obtain all transformer loss information from the manufacturer and match the transformer to the load profile. Manufacturers trade off coil losses (most significant at full load) with core losses (most significant at low load). Consequently, a low-temperature-rise unit that operates very efficiently at high load may be inefficient at low load.

Each year, according to insurance industry figures, more than 100 incidents of electrical and fire damage are caused by inadequate transformer maintenance, resulting in $10 million in losses.

Disconnect the primary side of transformers not serving active loads. Transformers consume power even when loads are switched off or disconnected. Disconnecting the primary side of transformers to reduce transformer standby losses is safe, provided that critical equipment such as clocks, fire alarms, and heating control circuits are not affected.

For three-phase transformers, ensure that the voltage of each phase is balanced with others to within the minimum transformer step. If this fails to yield equal tap settings, redistribution of the loads is needed.

Though not particularly glamorous in appearance, this Honeywell TranStar, the first ultra-low-loss transformer available in North America, achieves 98.5% efficiency at 35% load unit and could save users up to $3,500 each year. Source: Honeywell

Reduce acoustical noise from pad-mounted transformers through proper design. In areas where personnel might be affected by the 60 Hz hum of power transformers, use isolators to reduce transmission to the building's structural components. Install isolators between the transformer core and housing, and also between the housing and the building structure.

Visually inspect transformers to verify that oil is contained and that connections appear to be sound.

Scan temperatures of transformers using infrared thermography to determine points of energy waste and pending failure. Criteria for assessment include ambient air temperature, rated-rise of similar transformers under the same conditions, and an absolute maximum allowable temperature.

Maintain balanced voltage with polyphase transformers by maintaining equal tap settings. Balance single-phase loads among phases to keep voltages within 1% of the average.

Be careful when connecting single-phase transformers to a three-phase system. If the load is large, a three-phase transformer should be used and the single-phase loads should be balanced.

Cooling oil in old transformers may contain polychlorinated biphenyls. PCBs are hazardous, cancer-causing agents that must not be released into the environment. Use extreme care to avoid spillage when replacing PCB-containing transformers. Collect oils for recycling or disposal at an approved hazardous waste facility. Follow applicable safety and environmental protection standards for handling and disposal.

References

Guide for Determining Energy Efficiency for Distribution Transformers. NEMA Standards Publication TP 1-1996, National Electrical Manufacturers Association (NEMA), Rosslyn, VA; www.nema.org.

"Honeywell TranStar Transformer Offers Significant Savings," *Environmental Building News*, Vol. 9, No., 7/8, July/August 2000; BuildingGreen, Inc., Brattleboro, VT; (800) 861-0954; www.BuildingGreen.com.

Contacts

Consortium for Energy Efficiency, Inc., One State Street, Suite 1400, Boston, MA 02109; (617) 589-3949; www.CEEforMT.org.

U.S. Environmental Protection Agency ENERGY STAR Program; (888) STAR-YES; www.epa.gov/appdstar/transform/.